Federal Democratic Republic of Ethiopia

☞ EDICT OF GOVERNMENT ☜

In order to promote public education and public safety, equal justice for all, a better informed citizenry, the rule of law, world trade and world peace, this legal document is hereby made available on a noncommercial basis, as it is the right of all humans to know and speak the laws that govern them.

ET ISO 5270.DS (2012) (English): Pulps -- Laboratory sheets -- Determination of physical properties

ISO INSIDE

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

ETHIOPIAN STANDARD

ES ISO 5270:2012

First edition

Pulps — Laboratory sheets — Determination of physical properties

ICS: 85.040

Published by Ethiopian Standards Agency

©ESA

Foreword

This Ethiopian Standard has been prepared under the direction of the Technical Committee for paper and pulp Products (TC 3) and published by the Ethiopian Standards Agency (ESA).

The standard is identical with ISO 5270:1998 Pulps — Laboratory sheets —Determination of physical properties published by ISO 1998(E) .

For the purpose of this Ethiopian Standard, the adopted text shall be modified as follows.

- The phrase “International Standard” shall be read as “Ethiopian Standard”; and
- A full stop (.) shall substitute comma (,) as decimal marker.

ETHIOPIAN STANDARD **ES ISO 5270:2012(E)**

Pulps — Laboratory sheets — Determination of physical properties

1 Scope

This International Standard specifies test methods for the determination of some physical properties of laboratory sheets made of pulp. It is intended for laboratory sheets prepared in accordance with ISO 5269-1 or ISO 5269-2 and shall be used in conjunction with the relevant International Standards for the corresponding test methods for paper to which reference is made.

The methods specified in this International Standard deviate, in certain instances, from those specified in the relevant International Standards for paper due to the limited amount of test material available.

NOTE — The preparation of laboratory sheets for the determination of the diffuse blue reflectance factor (ISO brightness pulp is specified in ISO 3688. The measurement of ISO brightness of paper, board and pulps is described in ISO 2470.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 187:1990, *Paper, board and pulps — Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples.*

ISO 534:1988, *Paper and board — Determination of thickness and apparent bulk density or apparent sheet density.*

ISO 1924-2:1994, *Paper and board — Determination of tensile properties — Part 2: Constant rate of elongation method.*

ISO 1974:1990, *Paper — Determination of tearing resistance (Elmendorf method).*

ISO 2493:1992, *Paper and board — Determination of resistance to bending.*

ISO 2758:1983, *Paper — Determination of bursting strength.*

ISO 5269-1:— 1), *Pulps — Preparation of laboratory sheets for physical testing — Part 1: Conventional sheet-former method.*

ISO 5269-2:— 2), *Pulps — Preparation of laboratory sheets for physical testing — Part 2: Rapid-Köthen method.*

ISO 5626:1993, *Paper — Determination of folding endurance.*

ISO 5636-5:1986, *Paper and board — Determination of air permanence (medium range) — Part 5: Gurley method.*

ISO 7263:1994, *Corrugating medium — Determination of the flat crush resistance after laboratory fluting.*

---

1) To be published. (Revision of ISO 5269-1:1979)

2) To be published. (Revision of ISO 5269-2:1980)

ISO 9895:1989, *Paper and board — Compressive strength — Short span test.*

ISO 12192:—[3], *Paper and board — Compressive strength — Ring crush method.*

3 Principle

Determination of physical properties of pulp, such as apparent bulk density, tensile index, tear index, burst index, air permeance, folding endurance, resistance to bending, and compressive strength, using laboratory sheets prepared from suspensions of unbeaten or beaten pulp and in equilibrium with the standard atmosphere for conditioning.

4 Apparatus

The equipment is specified in the respective International Standards referred to.

5 Trimmed laboratory sheets

5.1 Selection of laboratory sheets

Select the number of sheets required according to the properties tested. However, a minimum of four laboratory sheets shall be selected. Each sheet shall be free of visible defects and shall be prepared so as to have a grammage (oven-dry basis) of 60 g/m^2 ± 2 g/m^2 as specified in ISO 5269-1 or 75 g/m^2 ± 2 g/m^2, as specified in ISO 5269-2. For unspecified grammages (see table 1 in 5.4) a tolerance of 3 % is applied. The sheets form a set which shall have a total area of not less than 0,1 m^2. For sheets prepared in accordance with ISO 5269-2, it is recommended that a set of 10 sheets, which are without visible imperfections, be used. The sheets should not be preconditioned.

NOTE — Sheet grammage on a conditioned basis would be approximately 65 g/m^2 for sheets according to ISO 5269-1, and 81 g/m^2 for ISO 5269-2. For sheets intended for determination of bending resistance and compressive strength properties, the grammage on a conditioned basis will not be specified.

5.2 Conditioning of laboratory sheets

Condition the laboratory sheets at 23 °C ± 1 °C and 50 % ± 2 % relative humidity as specified in ISO 187 and keep them in the conditioning atmosphere until testing is completed.

5.3 Determination of grammage, thickness and apparent bulk density

Trim the sheets to obtain a well-defined size, and determine the area to an accuracy of 0,5 %. Consult table 1 in 5.4 to establish a suitable size for the trimmed sheets that allows them to be used for cutting test pieces.

Before cutting test pieces, determine the grammage of the conditioned trimmed sheets in accordance with the following procedure.

Determine the mass of the trimmed sheets by weighing to an accuracy of 0,2 %. Calculate the grammage g, in grams per square metre, from the formula

$$g = \frac{m}{A \times n}$$

where

m is the mass, in grams, of the conditioned trimmed sheets;

A is the area, in square metres, of one sheet;

n is the number of sheets.

---

[3] To be published.

Record the result to the first decimal place.

With the precision micrometer described in ISO 534, measure the thickness of a pile consisting of four trimmed sheets with their non-glossy sides up. (Rapid-Köthen sheets have no glossy sides.) Take measurements at five different places in the pile, taking care that the sheets are not displaced when changing the position of the pile for each measurement. Calculate the mean thickness of a single sheet.

Calculate the apparent bulk density ρ, in kilograms per cubic metre, from the formula

$$\rho = \frac{g \times 1000}{\bar{\delta}}$$

where

g is the grammage, in grams per square metre, of the conditioned trimmed sheet;

$\bar{\delta}$ is the mean thickness, in micrometres, of a single sheet as calculated in the previous paragraph.

Calculate the mean apparent bulk density and report the result to two significant figures.

5.4 Preparation of test pieces

Cut a sufficient number of test pieces from the conditioned trimmed sheets. The minimum requirements are given in table 1.

NOTE — If a circular sheet of diameter 158 mm is used, only two test pieces for the determination of flat crush resistance or ring crush resistance can be cut from each such sheet. These test pieces may be used for the determination of grammage.

Table 1

Property	**International Standard**	**Target grammage** g	**Test piece dimensions** mm		**Minimum number of test pieces**
			Length	Width	
Tensile index	ISO 1924-2	60 or 75	At least 100 ± 2 mm between clamps + extra length for complete clamping	$15 \pm ^{0,2}_{0,1}$	8 from at least 4 sheets
Tear index	ISO 1974	60 or 75	According to the testing apparatus		2 [1] from at least 4 sheets
Burst index	ISO 2758	60 or 75	Wide enough to be securely clamped		8 from at least 4 sheets
Folding endurance	ISO 5626	60 or 75	According to the testing apparatus	15,0 ± 0,1	6 from at least 3 sheets
Resistance to bending	ISO 2493	[2]	$\geqslant 70$	38,0 ± 0,2	6 from at least 2 sheets
Flat crush resistance	ISO 7263	[2]	$\geqslant 150$	12,7 ± 0,1	10 from at least 2 sheets
Compressive strength — Short span test	ISO 9895	[2]	$\geqslant 70$	15,0 ± 0,1	10 from at least 2 sheets
Compressive strength — Ring crush method	ISO 12192	[2]	150 to 152,5	12,7 ± 0,1	10 from at least 2 sheets

1) One test piece consists of four pieces cut from at least two trimmed sheets.

2) Unspecified.

6 Procedures for general physical properties (60 g/m^2 or 75 g/m^2 sheets)

6.1 Tensile index

Determine the tensile strength and, if required, stretch at break by the procedure specified in ISO 1924-2. Test at least two test pieces from each sheet and a minimum of eight test pieces altogether. The distance between the clamps shall be 100 mm ± 2 mm and the rate of elongation 10 mm/min ± 2,5 mm/min.

NOTES

1 If the length of a test piece is not sufficient to avoid the clamps touching the surface of the test area, a test length of 90 mm may be used. This deviation should be stated in the test report.

2 For some qualities, the test piece may fail quickly, for example in less than 5 s, or take some time, for example more than 30 s. In such cases, a different constant rate of elongation may be used, but this rate must be stated in the test report.

Calculate the tensile index I, in newton metres per gram, from the formula

$$I = \frac{\overline{F}}{w \times g}$$

where

$\overline{F}$ is the mean scale reading, in newtons;

w is the width, in metres, of the test piece;

g is the grammage, in grams per square metre, of the conditioned trimmed sheets, determined in accordance with 5.3.

Calculate the mean tensile index and report the result to the nearest 0,5 N·m/g.

If required, calculate the mean stretch at break of the pieces in millimetres, then calculate the stretch at break as a percentage of the initial test span and express the result to the first decimal place.

6.2 Tear index

Determine the tearing resistance as described in ISO 1974, using test pieces which consist of four pieces. Clamp the test pieces so that their non-glazed sides face the shaft of the pendulum. Carry out at least two such tests.

Calculate the mean scale reading. Then calculate the tearing resistance F, in millinewtons, and the tear index X, in millinewton square metres per gram, from the formulae

$$\overline{F} = \frac{\overline{F}p}{4}$$

$$X = \frac{F}{g}$$

where

$\overline{F}$ is the mean scale reading, in millinewtons;

p is the number of pieces torn simultaneously for which the pendulum scale has been calibrated to give a direct tearing-resistance reading, in millinewtons (commonly the value of this factor is 4, 8, 16 or 32);

g is the grammage, in grams per square metre, of the conditioned trimmed sheets, determined in accordance with 5.3.

Report tear index values to the nearest 0,1 mN·m^2/g.

6.3 Burst index

Determine the bursting strength as specified in ISO 2758. Carry out at least one burst test on each side of each of at least four specimens. Test pieces less than 70 mm × 70 mm in area may be used, provided that they are wide enough to be securely clamped.

Calculate the burst index X, in kilopascal square metres per gram, from the formula

$$X = \frac{\overline{P}}{g}$$

where

$\overline{P}$ is the mean bursting strength, in kilopascals;

g is the grammage, in grams per square metre, of the conditioned trimmed sheets, determined in accordance with 5.3.

Report burst index values to the nearest 0,1 kPa·m^2/g.

6.4 Air permeance

Determine the air permeance as specified in ISO 5636-5. The air pressure shall be applied to the non-glossy side of the sheets.

Perform at least four determinations on test pieces from at least two trimmed laboratory sheets and calculate the mean time, in seconds, for the passage of 100 ml of air.

Calculate the air permeance P, in micrometres per pascal second, to two significant figures from the formula

$$P = \frac{127}{\overline{t}}$$

where $\overline{t}$ is the mean time, in seconds, for the passage of 100 ml of air.

6.5 Folding endurance

Using one of the procedures specified in ISO 5626, determine the logarithm (to the base 10) of the number of double folds obtained on each test piece. Test at least six test pieces taken from at least three trimmed laboratory sheets.

Report the mean of the logarithms to the second decimal place as the folding endurance. Also state the type of tester used.

7 Procedures for certain physical properties (high grammage sheets)

7.1 Resistance to bending

Determine resistance to bending of the test pieces according to the procedure described in ISO 2493. If the instrument is so designed that deflection is possible only to one side of the unstressed position, equal numbers of test pieces with opposing surfaces towards the direction of deflection shall be tested.

Carry out measurements on at least ten test pieces and calculate the mean value of the resistance to bending $\overline{B}$, in millinewtons. Calculate the bending resistance index X, in Nm^6/kg^3, from the formula

$$X = \frac{\overline{B} \times 10^6}{g^3}$$

where

$\overline{B}$ is the mean resistance to bending of the test pieces, in millinewtons;

g is the grammage, in grams per square metre, of the conditioned trimmed sheets, determined in accordance with 5.3.

Report the bending resistance index to three significant figures together with the clamping length and bending angle used.

7.2 Flat crush resistance after laboratory fluting, CMT

Determine the flat crush resistance, CMT, of the test pieces by the procedure described in ISO 7263. The non-glossy side of the test piece shall face the adhesive tape.

Carry out at least six measurements and calculate the mean flat crush compressive force $\overline{F}$ in newtons. Calculate the flat crush resistance index X, in Nm^2/g, from the formula

$$X = \frac{\overline{F}}{g}$$

where

$\overline{F}$ is the mean flat crush compressive force of the test pieces, in newtons;

g is the grammage, in grams per square metre, of the conditioned trimmed sheets, determined in accordance with 5.3.

Report the flat crush resistance index to three significant figures.

7.3 Ring-crush resistance, RCT

Determine the ring-crush resistance, RCT, of the test pieces according to the procedure described in ISO 12192. Place the test pieces so that the non-glossy and glossy side of the material alternately face the centre of the cylinder formed by the test piece. Carry out at least ten measurements and calculate the mean ring-crush resistance $\overline{C}$, in newtons per metre, and the ring crush resistance index X, in newton metres per gram, from the formulae.

$$\overline{C} = \frac{\overline{r}}{l}$$

$$X = \frac{\overline{C}}{g}$$

where

$\overline{r}$ is the mean ring-crush compressive force of the test pieces, in newtons;

l is the length of the test piece in metres;

X is the ring-crush resistance index, in newton metres per gram;

g is the grammage, in grams per square metre, of the conditioned trimmed sheets, determined in accordance with 5.3.

Report the ring-crush resistance index to three significant figures.

7.4 Short span compressive strength

Determine the short span compressive strength of the test pieces according to the procedure described in ISO 9895.

Carry out at least 10 measurements. Calculate the mean value of the maximum compressive force, in newtons, to the nearest 0,1 N. Calculate the compressive strength X, in kilonewtons per metre, and the compression index Y, in newton metres per gram, from the formulae

$$X = \frac{\overline{F}}{15}$$

$$Y = \frac{1000\ X}{g}$$

where

$\overline{F}$ is the mean maximum compressive force of the test pieces, in newtons;

15 is the width of the test piece, in millimetres;

g is the grammage, in grams per square metre, of the conditioned trimmed sheets, determined in accordance with 5.3.

Report the compression index to the nearest 0,1 Nm/g.

8 Test report

The test report shall include the following particulars:

a) reference to this International Standard;

b) all the indications necessary for complete identification of the sample of pulp;

c) if the laboratory sheets have been prepared from laboratory-beaten pulp, reference to the relevant International Standard and the relevant particulars listed in the test report in that standard;

d) if the sheets have been prepared from unbeaten pulp, or pulp beaten otherwise than by a standard method, reference to the relevant International Standard for the method of disintegration and the relevant particulars listed in the test report in that standard;

e) the actual conditioned grammage of the sheets;

f) reference to the International Standard for the preparation of laboratory sheets (ISO 5269-1 or ISO 5269-2);

g) reference to the test methods used;

h) the standard atmosphere for conditioning and testing;

i) whether the equilibrium with the given conditioning atmosphere is reached by desorption or by sorption;

j) the results and details stated in the relevant paragraphs in clauses 6 and 7 of this International Standard;

k) any unusual procedures used or features observed in the course of the test, in particular the rate of elongation for tensile index, if it is different from 10 mm/min ± 2,5 mm/min;

l) any operations not specified in this International Standard, or in the International Standards to which reference is made or regarded as optional, which might have affected the results.

Annex A
(informative)

Bibliography

[1] ISO 2470:—[4], *Paper, board and pulps — Measurement of diffuse blue reflectance factor (ISO brightness).*

[2] ISO 3688:—[5], *Pulp — Measurement of diffuse blue reflectance factor (ISO brightnes*

የኢትዮጵያ የደረጃዎች ኤጀንሲ
Ethiopian Standards Agency

Organization and Objectives

The Ethiopian Standards Agency (ESA) is the national standards body of Ethiopia established in 2010 based on regulation No. 193/2010.ESA is established due to the restructuring of Quality and Standards Authority of Ethiopia (QSAE) which was established in 1970.

ESA's objectives are:-

- Develop Ethiopian standards and establish a system that enable to check weather goods and services are in compliance with the required standards,
- Facilitate the country's technology transfer through the use of standards,
- Develop national standards for local products and services so as to make them competitive in the international market.

Ethiopian Standards

The Ethiopian Standards are developed by national technical committees which are composed of different stakeholders consisting of educational Institutions, research institutes, government organizations, certification, inspection, and testing organizations, regulatory bodies, consumer association etc. The requirements and/ or recommendations contained in Ethiopian Standards are consensus based that reflects the interest of the TC representatives and also of comments received from the public and other sources. Ethiopian Standards are approved by the National Standardization Council and are kept under continuous review after publication and updated regularly to take account of latest scientific and technological changes.
Orders for all Ethiopian Standards, International Standard and ASTM standards, including electronic versions, should be addressed to the Documentation and Publication Team at the Head office and Branch (Liaisons) offices. A catalogue of Ethiopian Standards is also available freely and can be accessed in from our website.

ESA has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of ESA.

International Involvement
ESA, representing Ethiopia, is a member of the International Organization for Standardization (ISO), and Codex Alimentarius Commission (CODEX). It also maintains close working relations with the international Electro-technical Commission (IEC) and American Society for Testing and Materials (ASTM).It is a founding member of the African Regional Organization for standardization (ARSO).

More Information?
Contact us at the following address.
The Head Office of ESA is at Addis Ababa.

☎ 011- 646 06 85, 011- 646 05 65
📠 011-646 08 80
✉ 2310 Addis Ababa, Ethiopia
E-mail: info@ethiostandards.org,
Website: www.ethiostandards.org

Standard Mark